Syllabus
Advanced Quantitative Methods: Causal Inference
Aarhus University, Spring 2026

Jan P. Vogler

February 4, 2026

Time & Place
See below and on https://timetable.au.dk/schedule

Contact:
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Short Description

This course presents a modern approach to studying causal questions in political science. In the first half of the course, we introduce (1) the core concepts of causality and inference, (2) the logic of experimental designs, and (3) an essential empirical tool for analyzing data — linear regression. In the second part of the course, we systematically go through a variety of strategies for identifying causal effects using observational data, including matching, differences-in-differences, regression discontinuity designs, and others. Throughout, we will examine particular research papers that have successfully applied causal inference methods, and we will also give you numerous opportunities to use the different methods through regular assignments.

The overall goal of the course is for students to become critical consumers of causal claims in the social sciences and to provide all participants with the knowledge and tools needed to do causal inference in practice.

Intended Learning Outcomes

After having participated actively in the course, students will be able to:

- present the central assumptions and principles behind key research designs for causal inference
- interpret statistical results related to these designs, and clearly articulate substantive conclusions derived from various existing causal studies

- discuss the strengths and weaknesses of specific causal inference approaches vis-à-vis other approaches that could be used alternatively
- develop well-founded research designs and analytical strategies with the aim of investigating concrete causal questions.

Exam

30-minute oral exam with no assistance. You will draw an excerpt from an empirical article. You then have 30 minutes to gain an overview of the research question, data properties, identification strategy, and test results, which you will have to present. Following the presentation, the examiner will ask you questions about its content as well as different aspects of the remainder of the course.

Class Activities

In the first class you will be split into study groups. You can use these study groups to complete the weekly assignments.

Software

In class, we will use the statistical programming language `R` and `Stata 16`. `RStudio` can be downloaded for free online. A license to Stata can be bought online via the department's website. You are free to use whichever software you prefer.

Inclusion

An essential goal of the course is to create an open and welcoming discussion atmosphere, based on which we can have a positive conversation about the theory and practice of causal inference. In our discussions, diversity of opinions, constructive discussion, and mutual respect will be key elements. A heterogeneity in backgrounds, experiences, and identities will greatly benefit us by allowing us to learn from each other and expand our thinking. All students are encouraged to voice their opinions and to do so in a way that displays respect for the opinions of other students in the course. Students who believe that these goals are inhibited in any way should contact me so that we can discuss their concerns.[1]

Academic Integrity

A second essential goal is to uphold the standards of academic integrity in this course. Group-based work is expected to be done only by those who are officially assigned to the respective task. The final examination has to be completed

[1] The wording of the sections on inclusion and academic integrity was adopted from a previous course syllabus by the instructor (JPV).

without the use of any electronic devices. If you have any questions about academic integrity, please contact us so that we can discuss them.

Books

We will use longer excerpts from the following books:

- Angrist, J., & Pischke, J. S. (2009). *Mostly harmless econometrics: An empiricist's companion*. Princeton University Press. [**AP:MHE**]

  Also available as e-book at this link.

- Stock, J. H., & Watson, M. W. (2020). *Introduction to econometrics* (4th ed.). Pearson. [**SW:IE**]

- Gerber, A. S., & Green, D. P. (2012). *Field experiments: Design, analysis, and interpretation*. W. W. Norton. [**GG:FE**]

If you have a previous version of *Stock and Watson*, feel free to use it. I recommend that you purchase both *Mostly Harmless* and the *Field Experiments* book. The latter cannot be purchased from *Politologisk Boghandel* (PB), but can be acquired online. The chapters you will have to read from *Field Experiments* are also available as pre-prints and can be found on the internet.

Class Overview

Texts marked by a ($\star$) are in the curriculum. Extra/supplemental (i.e., non-mandatory) readings are marked by a ($\triangleright$).

Please note that the syllabus is preliminary and that I might still make minor modifications.

Class 1: What is a Causal Effect?
(JPV, Date and Time: February 6 [Friday], 9–12. 1325-136 Undervisningslokale.)

- ⋆ Angrist, J., & Pischke, J. S. (2009). *Mostly harmless econometrics: An empiricist's companion* [**AP:MHE**]. Princeton University Press. Chapters 1–2: Questions about questions & The experimental ideal (pp. 1–24).
- ⋆ Samii, C. (2016). Causal empiricism in quantitative research. *The Journal of Politics, 78*(3), 941–955.
- ⋆ Rohrer, J. M. (2018). Thinking clearly about correlations and causation: Graphical causal models for observational data. *Advances in Methods and Practices in Psychological Science, 1*(1), 27–42.
- ▷ Holland, P. W. (1986). Statistics and causal inference. *Journal of the American Statistical Association, 81*(396), 945–960.
- ▷ Grossman, G., Dinneen, W., & Torreblanca, C. (2026). Political Science Under Pressure: Competition and Collaboration in a Growing Discipline, 2003–2023. *Perspective on Politics*.
- ▷ Torreblanca, C., Dinneen, W., Grossman, G., & Xu, Y. (2025). The Credibility Revolution in Political Science. *arXiv preprint arXiv*:2601.11542.

Class 2: Inference in Theory
(JPV, Date and Time: February 13 [Friday], 9–12. 1325-136 Undervisningslokale.)

- ⋆ Gailmard, S. (2014). *Statistical modeling and inference for social science*. Cambridge University Press. Read only specific parts of Chapters 2, 7, and 8 (pp. 43–61, 207–226, 266–274):

  2.3.5 Regression

  2.3.6 Multiple regression

  2.3.7 Specifying regression models

  7.5 Sample regression coefficients with IID draws

  7.6 Derived distributions: Sampling from normal DGPs when sigma-squared must be estimated

  8.5 Tests about regression coefficients

- ⋆ Wooldridge, J. M. (2020). *Introductory econometrics: A modern approach* (7th ed.). Cengage Learning. Appendix C and Chapter 3.4: Fundamentals of mathematical statistics & The variance of the OLS estimators (pp. 714–748 & pp. 87–95).
- ⋆ Williams, M. J. (2026). Causal inference, agency, and the problem of inherent endogeneity. *Annual Review of Political Science*, pp. 1–20.

⋆ Heß, S. (2017). Randomization inference with Stata: A guide and software. *The Stata Journal, 17*(3), 630–651.

▷ Wooldridge, J. M. (2020). *Introductory econometrics: A modern approach* (7th ed.). Cengage Learning. Appendix A–B: Basic mathematical tools & Fundamentals of probability (pp. 666–713).

→ *Read Appendices A and B for information on some of the notation and operators we will use.*

Class 3: Inference in Practice
(JPV, Date and Time: February 20 [Friday], 9–12. 1325-136 Undervisningslokale.)

⋆ Simmons, J. P., Nelson, L. D., & Simonsohn, U. (2011). False-positive psychology: Undisclosed flexibility in data collection and analysis allows presenting anything as significant. *Psychological Science, 22*(11), 1359–1366.

⋆ Duflo, E., Banerjee, A., Glennerster, R., & Kremer, M. (2006). Using randomization in development economics: A toolkit. In T. P. Schultz & J. Strauss (Eds.), *Handbook of development economics* (Vol. 4, pp. 3895–3962). Elsevier. [Read only Section 4.1: Sample size, design, and the power of experiments] https://papers.ssrn.com/sol3/papers.cfm?abstract_id=951841

⋆ Gelman, A., & Carlin, J. (2014). Beyond power calculations: Assessing type S (sign) and type M (magnitude) errors. *Perspectives on Psychological Science, 9*(6), 641–651.

▷ Open Science Collaboration. (2015). Estimating the reproducibility of psychological science. *Science, 349*(6251), aac4716 (pp. 1–9).

▷ Lenz, G. S., & Sahn, A. (2021). Achieving statistical significance with control variables and without transparency. *Political Analysis, 29*(3), 356–369.

▷ Ioannidis, J. P. A., Stanley, T. D., & Doucouliagos, H. (2017). The power of bias in economics research. *The Economic Journal, 127*(605), F236–F265.

Class 4: Designing Experiments
(JPV, Date and Time: February 27 [Friday], 9–12. 1325-136 Undervisningslokale.)

⋆ McDermott, R. (2002). Experimental methods in political science. *Annual Review of Political Science, 5*(1), 31–61.

⋆ Slothuus, R. (2016). Assessing the influence of political parties on public opinion: The challenge from pretreatment effects. *Political Communication, 33*(2), 302–327.

- ⋆ Dafoe, A., Zhang, B., & Caughey, D. (2018). Information equivalence in survey experiments. *Political Analysis, 26*(4), 399–416.

- ⋆ Deaton, A., & Cartwright, N. (2018). Understanding and misunderstanding randomized controlled trials. *Social Science & Medicine, 210*, 2–21.

- ▷ Sniderman, P. M., & Grob, D. B. (1996). Innovations in experimental design in attitude surveys. *Annual Review of Sociology, 22*(1), 377–399.

- ▷ Imbens, G. W. (2018). *Comments on: Understanding and misunderstanding randomized controlled trials by Cartwright and Deaton*. Stanford University, Graduate School of Business.

Class 5: Analyzing Experiments
(JPV, Date and Time: March 6 [Friday], 9–12. 1325-136 Undervisningslokale.)

- ⋆ Gerber, A. S., & Green, D. P. (2012). *Field experiments: Design, analysis, and interpretation* [**GG:FE**]. W. W. Norton. Chapters 2, 4, and 7: Causal inference and experimentation, Using covariates in experimental design and analysis, & Attrition (pp. 21–46, 95–123, 211–244).

- ⋆ Bullock, J. G., Green, D. P., & Ha, S. E. (2010). Yes, but what's the mechanism? (don't expect an easy answer). *Journal of Personality and Social Psychology, 98*(4), 550–558.

- ⋆ Enos, R. D. (2014). Causal effect of intergroup contact on exclusionary attitudes. *Proceedings of the National Academy of Sciences, 111*(10), 3699–3704.

- ▷ Gerber, A. S., & Green, D. P. (2012). *Field experiments: Design, analysis, and interpretation* [**GG:FE**]. W. W. Norton. Chapter 1: Introduction (pp. 1–19).

Class 6: Analyzing Observational Data with Linear Regression
(JPV, Date and Time: March 13 [Friday], 9–12. 1325-136 Undervisningslokale.)

- ⋆ Cunningham, S. (2021). Probability and regression review. In *Causal inference: The mixtape*. Yale University Press. Available at https://mixtape.scunning.com/02-probability_and_regression. Read only the following sections:

  2.11 Population model

  2.12 Mean independence

  2.13 Ordinary least squares

  2.14 Algebraic properties of OLS

  2.15 Goodness-of-fit

  2.16 Expected value of OLS

2.18 CEF decomposition property

2.19 CEF prediction property

2.25 Variance of the OLS estimators

⋆ Aronow, P. M., & Samii, C. (2016). Does regression produce representative estimates of causal effects? *American Journal of Political Science, 60*(1), 250–267.

▷ Angrist, J., & Pischke, J. S. (2009). *Mostly harmless econometrics: An empiricist's companion* [**AP:MHE**]. Princeton University Press. Chapter 3: Making regression make sense (pp. 27–110).

▷ Wooldridge, J. M. (2020). *Introductory econometrics: A modern approach* (7th ed.). Cengage Learning. Chapters 6–7: Multiple regression analysis: Further issues & Multiple regression analysis with qualitative information (pp. 186–267).

Class 7: Interactive Models & Mid-term Assignment
(JPV, Date and Time: March 20 [Friday], 9–12. 1325-136 Undervisningslokale.)

⋆ Brambor, T., Clark, W. R., & Golder, M. (2006). Understanding interaction models: Improving empirical analyses. *Political Analysis, 14*(1), 63–82.

⋆ Hainmueller, J., Mummolo, J., & Xu, Y. (2019). How much should we trust estimates from multiplicative interaction models? Simple tools to improve empirical practice. *Political Analysis, 27*(2), 163–192.

▷ Esarey, J., & Sumner, J. L. (2018). Marginal effects in interaction models: Determining and controlling the false positive rate. *Comparative Political Studies, 51*(9), 1144–1176.

Class 8: Matching
(JPV, Date and Time: March 27 [Friday], 9–12. 1325-136 Undervisningslokale.)

⋆ Stuart, E. A. (2010). Matching methods for causal inference: A review and a look forward. *Statistical Science, 25*(1), 1–21.

⋆ Kam, C. D., & Palmer, C. L. (2008). Reconsidering the effects of education on political participation. *The Journal of Politics, 70*(3), 612–631.

⋆ King, G., & Nielsen, R. (2019). Why propensity scores should not be used for matching. *Political Analysis, 27*(4), 435–454.

⋆ Quinn, K. M., Liu, G., Epstein, L., & Martin, A. D. (2024). What to observe when assuming selection on observables. *Political Analysis, 32*(1), 1–22.

▷ Imbens, G. W. (2014). *Matching methods in practice: Three examples* (NBER Working Paper No. 19959). National Bureau of Economic Research.

▷ Ho, D. E., Imai, K., King, G., & Stuart, E. A. (2007). Matching as nonparametric preprocessing for reducing model dependence in parametric causal inference. *Political Analysis, 15*(3), 199–236.

Class 9: Natural Experiments & Auxiliary Analyses
(JPV, Date and Time: April 10 [Friday], 9–12. 1325-136 Undervisningslokale.)

⋆ Dunning, T. (2008). Improving causal inference: Strengths and limitations of natural experiments. *Political Research Quarterly, 61*(2), 282–293.

⋆ Athey, S., & Imbens, G. W. (2017). The state of applied econometrics: Causality and policy evaluation. *Journal of Economic Perspectives, 31*(2), 3–32. [Read only "Supplementary analyses" on pp. 17–21]

⋆ Becker, S. O., Mergele, L., & Woessmann, L. (2020). The separation and reunification of Germany: Rethinking a natural experiment interpretation of the enduring effects of communism. *Journal of Economic Perspectives, 34*(2), 143–171.

⋆ Eggers, A. C., Tuñón, G., & Dafoe, A. (2024). Placebo tests for causal inference. *American Journal of Political Science, 68*(3), 1106–1121.

Class 10: Difference-in-Differences
(JPV, Date and Time: April 13 [***Monday***], 9–12. 1325-136 Undervisningslokale.)

⋆ Huntington-Klein, N. (2021). *The effect: An introduction to research design and causality.* CRC Press. Chapter 18: Difference-in-differences. Available at https://theeffectbook.net/

⋆ Stock, J. H., & Watson, M. W. (2020). *Introduction to econometrics* [**SW:IE**] (4th ed.). Pearson. Section 1.3: Data: Sources and types (pp. 49–53).

⋆ Stock, J. H., & Watson, M. W. (2020). *Introduction to econometrics* [**SW:IE**] (4th ed.). Pearson. Sections 13.4–13.5: Quasi-experiments & Potential problems with quasi-experiments (pp. 490–498).

⋆ Malesky, E. J., Nguyen, C. V., & Tran, A. (2014). The impact of recentralization on public services: A difference-in-differences analysis of the abolition of elected councils in Vietnam. *American Political Science Review, 108*(1), 144–168.

▷ de Chaisemartin, C., & D'Haultfœuille, X. (2023). Two-way fixed effects and differences-in-differences with heterogeneous treatment effects: A survey. *The Econometrics Journal, 26*(3), C1–C30.

Class 11: Panel Data & Fixed Effects
(JPV, Date and Time: April 28 [***Tuesday***], ***15–18***. 1325-136 Undervisningslokale.)

- ⋆ Stock, J. H., & Watson, M. W. (2020). *Introduction to econometrics* [**SW:IE**] (4th ed.). Pearson. Chapter 10: Regression with panel data (pp. 361–391).
- ⋆ Angrist, J., & Pischke, J. S. (2009). *Mostly harmless econometrics: An empiricist's companion* [**AP:MHE**]. Princeton University Press. Chapter 5: Parallel worlds: Fixed effects, differences-in-differences, and panel data (pp. 221–247).
- ⋆ Van Noort, S. (2024). Industrialization and democracy. *World Politics, 76*(3), 457–498.
- ▷ Rabe-Hesketh, S., & Skrondal, A. (2012). *Multilevel and longitudinal modeling using Stata* (3rd ed.). Stata Press. (pp. 73–97 and 123–147).
- ▷ Rüttenauer, T., & Ludwig, V. (2023). Fixed effects individual slopes: Accounting and testing for heterogeneous effects in panel data or other multilevel models. *Sociological Methods & Research, 52*(1), 43–84.

Class 12: Interrupted Time Series & Synthetic Control
(JPV, Date and Time: May 1 [Friday], 9–12. 1325-136 Undervisningslokale.)

- ⋆ Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference*. Houghton Mifflin. Chapter 6: Interrupted time series (pp. 171–206).
- ⋆ Abadie, A., Diamond, A., & Hainmueller, J. (2015). Comparative politics and the synthetic control method. *American Journal of Political Science, 59*(2), 495–510.
- ⋆ Paglayan, A. S. (2021). The non-democratic roots of mass education: Evidence from 200 years. *American Political Science Review, 115*(1), 179–198.
- ⋆ McElreath, R. (2023). *Statistical rethinking 2023 online lectures* [Video]. Watch until 16:53 of Lecture 5: https://www.youtube.com/watch?v=iwVqiiXYeC4
- ⋆ Cao, J., & Chadefaux, T. (2025). Dynamic synthetic controls: Accounting for varying speeds in comparative case studies. *Political Analysis, 33*(1), 18–31.
- ▷ Abadie, A., Diamond, A., & Hainmueller, J. (2010). Synthetic control methods for comparative case studies: Estimating the effect of California's tobacco control program. *Journal of the American Statistical Association, 105*(490), 493–505.

▷ Gilchrist, D., Emery, T., Garoupa, N., & Spruk, R. (2023). Synthetic control method: A tool for comparative case studies in economic history. *Journal of Economic Surveys, 37*(2), 409–445.

▷ Ben-Michael, E., Feller, A., & Rothstein, J. (2022). Synthetic controls with staggered adoption. *Journal of the Royal Statistical Society Series B: Statistical Methodology, 84*(2), 351–381.

Class 13: Instrumental Variables
(JPV, Date and Time: May 8 [Friday], 9–12. 1325-136 Undervisningslokale.)

⋆ Angrist, J., & Pischke, J. S. (2009). *Mostly harmless econometrics: An empiricist's companion* [**AP:MHE**]. Princeton University Press. Chapter 4: Instrumental variables in action: Sometimes you get what you need (pp. 113–218). [Read only pp. 113–138]

⋆ Stock, J. H., & Watson, M. W. (2020). *Introduction to econometrics* [**SW:IE**] (4th ed.). Pearson. Chapter 12: Instrumental variables regression (pp. 427–473).

⋆ Acemoglu, D., Johnson, S., & Robinson, J. A. (2001). The colonial origins of comparative development: An empirical investigation. *American Economic Review, 91*(5), 1369–1401.

⋆ Lal, A., Lockhart, M., Xu, Y., & Zu, Z. (2024). How much should we trust instrumental variable estimates in political science? Practical advice based on 67 replicated studies. *Political Analysis, 32*(4), 521–540.

▷ Hariri, J. G. (2012). The autocratic legacy of early statehood. *American Political Science Review, 106*(3), 471–494.

▷ Mellon, J. (2025). Rain, rain, go away: 194 potential exclusion-restriction violations for studies using weather as an instrumental variable. *American Journal of Political Science, 69*(3), 881–898.

▷ Felton, C., & Stewart, B. M. (2026). Handle with care: A sociologist's guide to causal inference with instrumental variables. *Sociological Methods & Research, 55*(1), 3–50.

Class 14: Regression Discontinuity Design
(JPV, Date and Time: May 15 [Friday], 9–12. 1325-136 Undervisningslokale.)

⋆ Angrist, J., & Pischke, J. S. (2009). *Mostly harmless econometrics: An empiricist's companion* [**AP:MHE**]. Princeton University Press. Chapter 6: Regression discontinuity designs (pp. 251–267).

⋆ Skovron, C., & Titiunik, R. (2015). A practical guide to regression discontinuity designs in political science. *American Journal of Political Science, 59*(1), 1–17.

- ⋆ Kuipers, N., & Sahn, A. (2023). The representational consequences of municipal civil service reform. *American Political Science Review, 117*(1), 200–216.

- ⋆ De Magalhães, L., Hangartner, D., Hirvonen, S., Meriläinen, J., Ruiz, N. A., & Tukiainen, J. (2025). When can we trust regression discontinuity design estimates from close elections? Evidence from experimental benchmarks. *Political Analysis, 33*(3), 258–265.

- ⋆ Stommes, D., Aronow, P. M., & Sävje, F. (2023). On the reliability of published findings using the regression discontinuity design in political science. *Research & Politics, 10*(2), 1–12.

- ▷ Marshall, J. (2024). Can close election regression discontinuity designs identify effects of winning politician characteristics? *American Journal of Political Science, 68*(2), 494–510.

- ▷ Cattaneo, M. D., & Titiunik, R. (2022). Regression discontinuity designs. *Annual Review of Economics, 14*(1), 821–851.

Class 15: Review and Exam Preparation
(JPV, Date and Time: TBA, likely May 22)

- ⋆ No readings.